

over the lower third of the macula, with the exception of the Asaphidæ, Illænus and Lichas, of which they remark the entire macula shows "the structure which characterises" it as a visual organ. Beyond this, the macula, for which an average diameter of 0·99 mm. is given, is described as "oblong or ellipsoidal, and for two-thirds of its surface perfectly smooth or rather glossy," and its "granules" or lenses are estimated to be but 0·055 mm. in diameter at their largest.

With the maculae, as with the cephalic eyes, a wide range of modification is recognisable, which, if the authors' assumption of a visual function for the former be correct, leaves little doubt that the faceted type is for it a culminating one. They state that the maculae, "whether they show any organic structure or not," have commonly an "excessive thinness of their shell," and in so far as they enter into comparison with other Crustacea, while they call attention to the similarity "in the formation of the superior surface of the head in the Trilobites and the embryos and newly-hatched larvae of Limulus," they incline to the belief that, concerning the cephalic eyes, Limulus "stands completely isolated amongst all Arthropods," except for a certain resemblance between its cornea and that of Peltura." They similarly deny resemblance to the Phyllopods, and regard "the eyes of the Trilobites" as showing "the greatest conformity with those of the recent Isopods."

Full perusal of the details which they attribute to the hypostomial macula shows them to have discovered an interesting and important organ. Comparison is instituted between it and a thin area of the hypostome of the living Apus; but, if sound, there is not much to be said from this standpoint for the "eye" theory in any but the faceted forms. For the types which remain, the study of the remarkable details described in the memoir leaves us in doubt as to the evidence for the supposed visual function. Convinced of its actuality, however, in an attempt to bring the living Crustacea into line, the authors fall back upon the fact that in the embryo Limulus the median eyes have been described by Packard and others as originally ventral, and that there have been recorded for the Lepididæ two ventro-lateral eyes in an adult by Darwin, two ventro-lateral and a ventro-median one in a larva by Claparede, and similar indications by Hesse and Spence Bate.

Remarking upon the supposed habits of the Trilobites, of which we know nothing very definite beyond that a burrowing habit has been suggested, our authors express themselves averse to the popular idea that they "lived in abyssal depths . . . where the most intensive darkness prevailed." There are, however, considerations arising out of recent discovery concerning these animals worthy of note in this association. Owing to the wonderful conditions for preservation which characterise the Utica slate deposits near Rome, N.Y., certain Trilobites, during the last six to seven years there unearthed, as all zoologists are well aware, in the hands of Dr. Beecher, of Yale College, Conn., have yielded results of importance second to none in the palaeontology of the period. The proof that but one pair of antennæ were alone present, and that they were uniramous, brings the adult Triarthrus at once into line with the Nauplius larva, as distinct from all other known Crustacean forms; while that of a simple

uniformly jointed condition of the post-oral appendages, most, at least, of which were biramous, and of the Phyllopozan tendency of those posterior and last developed, more than fulfils the highest expectations of the philosophic morphologist, and amply justifies our trust in the larval form. One conspicuous feature of these appendages is the recurrent development from each of an inwardly directed and tapering gnathobase, most assuredly concerned with its fellows in the seizure of the prey and, by transfer of this from limb to limb, with its passage to the mouth. We know nothing of the habits of these animals as they swam, but from this feature the possibility is suggested that, like the living Apus, they may have swum upon their backs; and, if so, the presence of hypostomial eyes would become the more readily intelligible. On the other hand, the possibility that the "maculae" may have been luminous organs must not be overlooked; and bearing upon this surmise, it is well to remember that such organs are known to exist in a lenticulate and aggregated form, and that the probable presence of one of simple type in a sponge, taken in conjunction with the extent to which like organs are functional as a lure to the prey, would dispose of any anomaly in their possession by blind animals. And finally, inasmuch as the remarkable organs present in the Chitons, some of which, being lens-bearing, were by Moseley described as eyes, so far as experiment with light has yet progressed, have given but negative results, it becomes a question whether, until we know more concerning even these, the term "æsthetes" may not be well extended to them all. Arguing by analogy from these to the Trilobite "maculae," it must be admitted that their visual function is not proved.

In the further inquiry into the nature of these remarkable organs there lies a most promising field. As we cannot experiment with them, we provisionally retain an open mind concerning their functions; and while we are profoundly grateful to our authors for their intensely interesting memoir and the great labour they have bestowed upon it, we shall await with much interest the further results of their inquiry.

G. B. H.

THE RELATIONS OF THE OSTRICH-LIKE BIRDS.

On the Morphology and Phylogeny of the Palaeognathæ (Ratitæ and Crypturi) and Neognathæ (Carinatae). By W. P. Pycraft. *Trans. Zool. Soc. London*, vol. xv. pp. 149-290, pls. xlvi-xlv.

THE relation of the flightless ostrich-like birds (Mr. Pycraft says we must no longer call them Ratitæ) to more typical representatives of the class Aves has long been one of the puzzles of ornithology, and it is therefore a matter for satisfaction that the author of this important memoir has undertaken the task of revising and extending our knowledge of the anatomy of the existing members of the former group. The work was undertaken in connection with Mr. Walter Rothschild's revision of the cassowaries, of which, indeed, it forms the sequel; and the thorough manner in which it has been carried out forms a model of what such researches should be, and enables zoologists to draw their own conclusions on the questions at issue, if they are unable to accept all those at which the author arrives.

For a long time ornithologists have been hesitating whether or no to include the tinamus of South America in the same group as the ostrich-like birds ; but this hesitating spirit does not commend itself to Mr. Pycraft, who boldly says that the affinities between the two imperatively forbid their separation. And it is this innovation which leads him to reject the time-honoured title, Ratitæ.

The inclusion of the tinamus in the group renders it necessary to assume (even if we had not to do so on other grounds) that the ancestors of the ostrich and its kindred were formerly endowed with the power of flight. Further, the author regards the group as a convergent one, which has had a multiple origin from the common avian stem before this began to split up into the more specialised "Carinate" types. The cassowaries and emeus are regarded as representing the most primitive branch, which culminated, perhaps, in the more advanced ostrich. From this it apparently follows, although it is not stated in so many words by the author, that the divergence of the Ratites (to call them by their old name), including the tinamus, took place while birds still retained teeth. While this may be so, it must be confessed that some palæontological evidence in its favour would be most welcome.

It may be added that, according to the genealogical tree given by Mr. Pycraft, the loss of the teeth in birds must have taken place at a still later epoch, for we find the cretaceous Ichthyornis branching off long after the divers and ducks had been differentiated. This seemingly implies that the origin of the latter is to be carried back to the Jurassic epoch, when, so far as we yet know, *Archæopteryx* was the sole representative of bird life. The author promises a supplementary memoir on *Apteryx*, where he will, perhaps, explain how we are to get out of this difficulty.

A slight discrepancy between the aforesaid "tree" and the text likewise stands in need of explanation. On p. 264 of the latter it is stated that the ostrich-like birds "are to be regarded as polyphyletic—probably triphyletic," and yet in the "tree" we find them arising from five distinct branches.

Space does not allow of allusion to the many interesting observations on the osteology and pterylosis of the group recorded by Mr. Pycraft, but these really form a storehouse of information of the utmost value to future workers. As he himself would doubtless be one of the first to allow, opinions may legitimately differ in regard to many of the conclusions arrived at by the author, but as to the value of his investigations all opinion must be in accord.

R. L.

OUR BOOK SHELF.

Researches on the Past and Present History of the Earth's Atmosphere. By Dr. T. L. Phipson. Pp. xii + 194. (London : Charles Griffin and Co., Ltd., 1901.)

IN style and scope, Dr. Phipson's book reminds us of essays submitted to the Smithsonian Institution for the Hodgkins Fund Prize, and afterwards published in the Smithsonian Report. A more or less popular description is given of the atmosphere in its various relationships to man, and in its meteorological aspects ; while in many places short statements are made of observations and

investigations carried out by the author himself. The book should thus prove of interest to general readers as well as to meteorologists and other students of science.

In the early chapters, the thesis which Dr. Phipson seeks to establish is "that the primitive atmosphere of the earth was nitrogen, into which volcanic action poured more or less carbonic acid and vapour, and that after vegetable life appeared, free oxygen made its appearance in the air, and has increased in quantity from those primitive times to the present day." In connection with the subject of the variations in the amount of carbon dioxide in the air, it might have been well to refer to the work of Arrhenius, Chamberlin and others on the effect of variations in the proportion of the gas in air upon the mean annual temperature, and past geological conditions.

Dr. Phipson regards argon as allotropic nitrogen or a carbide of nitrogen. The hydrogen gas driven off from meteorites when heated is, he holds, produced by the decomposition of water vapour by the meteorite during the passage through the air, or the absorption of water, the oxygen of which combines with some of the constituents of the meteorite when it is heated, thus setting hydrogen free. He refers to the variation in brightness of the star Algol as "still a mystery to astronomers," though the spectroscopic work of Vogel has placed the cause of variability almost beyond doubt. Like many other writers who have not followed closely the physical geography of recent years, Dr. Phipson believes in the Gulf Stream myth, going so far as to commit himself to the statement that "The mild climate of the British Isles is very greatly due to this immense current of warm water, without which we should be no better off, in this respect, than people who live in the Arctic circle." To understand how unfounded this statement is, we refer the author to a paper in the U.S. *Monthly Weather Review* of September 1900.

In a short chapter on meteorites the remark is made, "They are, no doubt, of the same composition as the moon ; and are, I believe, minute satellites of our earth, thrown off like our larger satellite was thrown off, in the earliest stages of its existence." Here again we have statements with little evidence to support them. Nothing is known of the exact composition of the moon, so the words "no doubt" in the sentence quoted are, to say the least, gratuitous.

While, therefore, we think the book contains an interesting account of the earth's atmosphere, we suggest that in several places statements are made as if they were accepted conclusions, whereas they are often opposed to the opinions of competent authorities.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). The Jurassic Flora. I. The Yorkshire Coast. By A. C. Seward, F.R.S. Pp. xii + 341; plates xxi. (London : British Museum (Natural History), 1900.)

FOSSIL plants from Grinstead Bay and neighbouring parts of the Yorkshire coast are so widely distributed among museum collections that Mr. Seward's descriptive catalogue of them will be welcomed by many museum curators in Britain and on the continent. But the volume is more than a catalogue ; it is a history of Oolitic plant-remains of Yorkshire, exemplified by the fine series preserved in the British Museum. In addition to the data provided by this material, the descriptions are based upon specimens in many other collections which have been examined and considered. As might have been expected, the identification of type-specimens was a difficult task, and in many cases it has been found impossible to specify the type, which fact, remarks Mr. Seward, "has afforded a practical demonstration of the need of some system for the centralisation and cataloguing of all specimens which have served for the diagnosis or illustration of new species."